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FROM PACK HORSE TO HELICOPTER

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by Hector A. Richmond

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PREFACE

Forest pest management in B.C. is going through an important transition. In the past we have relied largely on the guidance of research scientists; we are now beginning to place operational pest management specialists in the field. As we begin setting out policies and guidelines to direct these field activities, we are consulting widely with experts in many areas. But too often we neglect to find out what has happened in the past. The experiences of those who have preceded us are forgotten, or at least unrecorded.

It is my belief that the wisdom of our predecessors is a very important complement to the technical and scientific literature upon which we usually base our judgments. We are therefore very fortunate to have access to the writings of Hector Richmond, whose experience in pest management spans over half a century.

I first met Hector Richmond more than 15 years ago, when he was writing the Forest Pesticide Handbook for the Council of Forest Industries of B.C. and I was a research scientist at the (then) Chemical Control Research Institute in Ottawa. I was immediately impressed by his vast experience, the depth of his knowledge about pests, and his enthusiasm for pest management and the wise use of pesticides. Our second encounter was in 1977, at the technical conference held to discuss the proposed spraying of the Fraser Canyon. In that instance we held opposing views, but again I had high regard for his opinion.

My great satisfaction in knowing Hec Richmond, and my great respect for him as a pest manager, led me to persuade him to pass on to us some of his experience and advice. Presented as a collection of thoughts and anecdotes, this publication is intended primarily for people involved in pest management. Some of this material was published previously in Hec's book, Forever Green, or appeared in serial format in the newsletter of the Forest History Association. I hope you will find this unique publication to be a valuable reference as we set the direction of pest management for the coming years.

R.F. DeBoo, Manager
Pest Management
Protection Branch
B.C. Forest Service

IN THE BEGINNING

Over the years, the work of forest entomology has moved from the pack horse to the helicopter, from the laboratory bench and research plot to the fully operational field setting. In my sixty years of experience in this field, employed first by the federal government and later by the forest industry, I have observed and participated in many of these developments. My book, Forever Green[1], is an informal account of my youth and my career, including many stories of the early days of saddle and pack horse travel through remote forest zones of Alberta and British Columbia, and of the early efforts toward surveys and management of forest insect outbreaks.

More recently I have summarized additional details for historians in the Newsletter[2] of the British Columbia Forest History Association. This Pest Management Report has been written especially for another audience: the practising pest managers and foresters working for government agencies and the forest industry in B.C. today. It is my hope that some of the information and historical reflections presented here will be of value as background for decision making, especially in cases of major insect infestations.

The history of forest entomology in western Canada falls into three periods: the eras of Dr. J.M. Swaine, Mr. J.J. de Gryse, and Dr. M.L. Prebble. At different times, each of these men headed the Canada-wide forest entomology unit of the Entomological Branch of the Dominion Department of Agriculture, which operated under the authority of the Destructive Insect Pest Act. These three men exerted a marked influence on the science of forest entomology as it exists in Canada today.

It was during the administration of Dr. J.M. Swaine that the first organized work in forest entomology was established in western Canada. The headquarters for this was in Vernon.

The initial establishment of the Vernon laboratory stemmed from a massive outbreak of the bark beetle, Dendroctonus, in pine stands located in the Nicola and Similkameen regions of central British Columbia. Until the Ottawa government initiated this laboratory in about 1922, the control of bark beetles had been administered by the B.C. Forest Branch. The total staff at the Vernon laboratory consisted of four men: Ralph Hopping, in charge, George Hopping, assistant, and Bill Mathers and myself as research assistants. Our area of responsibility took in the provinces of B.C. and Alberta.

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[1] Richmond, H.A. 1983. Forever Green. Oolichen Press: Nanaimo.

[2] Richmond, H.A. 1984-1985. History of Forest Entomology. British Columbia Forest History Association Newsletter.

Although bark beetle control was the primary reason for establishing the centre, the need for other work soon became apparent. Bill Mathers was assigned to study the spruce budworm in the Cariboo country; George Hopping became responsible for researching the hemlock looper and wood borer (cedar pole borer and ambrosia beetles) on the Pacific coast; while I remained in charge of further bark beetle work in the Nicola and Similkameen regions. This was very fortunate for me, for, in addition to preferring this country, I was brought in very close contact with Dr. Swaine, the chief from Ottawa. Bark beetles constituted the primary interest of Swaine, who had published a book, "Canadian Bark Beetles," in 1918.

As chief of forest insect investigations in Canada, he was one of the most inspiring men I have ever been associated with. His periodic visits to the west were important events to us all, for in his wake he left a spirit of renewed enthusiasm.

To follow the course of Swaine's activities in the woods was like tracking the wanderings of an old bear. Every rotten stump or log was torn apart in his quest for various beetles while I, as an observer, would follow and gather up his lost or misplaced tools and equipment. He was much of the opinion that the best field work was done from a tent adjacent to the work at hand. He used to say that "a tent and an axe are the two most important tools you need."

It was through his administration that we experienced the "hungry thirties," the great Depression of the 1930's. For the next ten years, the work laboured under the restrictions and handicaps and uncertainties of the day. No permanent positions were created during those Depression years. With the exception of our chief, we were all on temporary status. Since no superannuation contributions were made during temporary employment, those years did not count in our eventual pension calculations.

The uncertainties of those times are indicated in a telegram received February 20, 1932. It was from Ottawa, signed by Dr. J.M. Swaine, Divisional Head, Entomology, Ottawa: "OWING TO RESTRICTIONS IN ESTIMATES, IT BECOMES NECESSARY TO DROP MOST TEMPORARY STAFF. DETAILED ADVICE WILL BE SENT AS SOON AS POSSIBLE. IN MEANTIME, TEMPORARY EMPLOYEES SHOULD MAKE NO COMMITMENTS BASED ON CONTINUANCE OF PRESENT EMPLOYMENT AFTER MARCH THIRTY-FIRST. THIS MAY NECESSITATE MOVEMENT OF SOME PERMANENTS TO OTHER STATIONS."

April came, and with it word that we need not continue any work unless we so wished. If our jobs were officially terminated as of March 31 and we continued working "on speculation," we would not be paid for time thus spent. On the other hand, if positions were eventually restored, we would be paid for those days worked. We all decided to remain on "spec," hoping for the continuation of our jobs. We had nothing else to do anyway! We waited in doubt and uncertainty until May 25, when our positions were renewed for another six months. In the meantime our pay was cut by 10 per cent, reducing my salary from $125 per month to $112.50. Ottawa then warned us of an impending additional cut in our pay of 22 per cent. Fortunately, this second cut never materialized.

During the Depression years there was little money for extra labour or seasonal help, and most work had to be done single-handed with very limited budgets. Only one student, Kenneth Graham, later to become Professor of Forest Entomology at the University of British Columbia, was employed as an itinerant assistant, alternating between one project and another as required. It was, however, a period of few outside pressures for finding the solutions to insect problems. There was minimal interest in conservation and forest protection. Unlike today, forests were considered inexhaustible and indestructible.

Dr. Swaine's administration as head of the Unit of Forest Entomology was terminated with his advancement to the position of Director, Science Service of the Department of Agriculture. The vacancy so created was filled through the appointment of Mr. J.J. de Gryse. It is impossible to imagine a more colourful personality than de Gryse. He stood out as a unique character among all who knew him, due, I think, to his unusual background.

De Gryse was the most learned man I have ever known. I spent many days travelling with him in B.C. and in the forest regions of central Canada, and I saw much of him in Ottawa. In the course of this time he told me much about himself, but there was much I would have liked to know which he never revealed. I never felt inclined to pry into his life beyond what he was willing to volunteer.

He was born in Belgium of a wealthy family prominent in the field of commerce. He entered the Catholic Church and studied as a Jesuit priest. Later he was transferred by the church to the United States, for reasons I do not know. He was subsequently loaned to the United States Department of Agriculture in Washington for some biological work. There his association with the Catholic Church came to an end. He quit the Church, came to Canada, and became employed with the Entomological Branch in Ottawa.

He was a man with a brilliant mind -- a fantastic organizer with great vision and imagination. He was very critical of the lackluster attitude of many government agencies. During his administration the Forest Insect Unit became an alive, farsighted, practical organization. He redesigned the entire service, its purpose, its aim and its objectives. He prompted the erection of the joint Provincial-Federal research laboratory in Sault Ste. Marie, proposed the eventual erection of the forest research centre as it now exists on Burnside Road in Victoria, initiated forest insect work in the forest regions of central Canada with headquarters in Winnipeg, and combined forest entomology and forest pathology into a single unit as the Division of Forest Biology. Among his more lasting contributions was the initiation of the Forest Insect Survey across Canada, which today constitutes one of the fundamental facets of the organization. Above all, he valued the cooperation and the support of the forest industry and provincial forest services, and directed much research toward practical problems found in both the private and public sectors.

It was de Gryse's conviction that forest problems should be administered under the wing of the Canadian Forestry Service. He wanted the Forest Insect Survey to be patterned after the Ranger organization of the provincial Forest Services. Each "insect ranger" was to be assigned to a specific district and provided with accommodation that would serve as his summer headquarters.

This plan met with immediate opposition within the Department of Agriculture in Ottawa, since it was not their policy to provide living accommodations for any of their employees. The issue was resolved by moving the Division of Forest Biology from the Department of Agriculture to the Dominion Forest Service. (Unfortunately, this was but the beginning of a long period of bureaucratic frustrations which saw the federal Forestry Service shuffled from one department to another. At one point — in 1969 — it was put together with fisheries into a department colloquially called "fish and chips." Eventually the Canadian Forestry Service settled under Environment Canada, where it remained until the middle of 1984 when it was moved as a whole into Agriculture Canada.)

The de Gryse period did not pass without its troubles, however, and a crisis of major importance erupted within the organization. While it had its origin in the east, it eventually engulfed the entire Canadian Forestry Service. The issue: "Why are men on the Pacific Coast supplied with caulk boots, while the fellows in eastern Canada are not?" This vital problem was settled quite simply by Dr. Neatby, the Director of the Science Service. Without so much as a Board of Inquiry or a Special Commission, he single-handedly decreed that henceforth no caulked boots would be supplied to anyone.

Shortly after that, by fortuitous circumstance, Dr. Neatby visited the west coast, and I, along with a couple of others, escorted him down the Nitinat to see the spectacular outbreak of hemlock looper. Enroute our trail took us across a very steep and deep canyon. Crossing this was accomplished by means of a "bridge," a large Douglas-fir tree that had been felled by cruisers at an earlier date. Such a crossing can be hazardous enough to anyone, but to the uninitiated it is terrifying, if not impossible.

Upon reaching this canyon, the rest of us crossed without undue concern, leaving Dr. Neatby for the moment, but intending to return and assist him across. He devised a solution on his own, however. Straddling the log, he inched his way across in a sitting position. The journey completed, he explained the problem quite simply: "Of course, you fellows had caulked boots which made your crossing quite simple."

With this I seized the opportunity to score a point for caulked boots: "No one can work safely in the coast forests without caulked boots."

There was never a question in the future with respect to the issue of caulked boots on the west coast.

To facilitate survey work on the Pacific Coast, a 60-foot [18m] vessel was purchased from War Assets to be used as a floating laboratory. The superstructure was redesigned to provide sleeping accommodation for seven men — skipper, engineer, cook and four others. In addition, it accommodated a compact laboratory. Because of its use as a transport for personnel, it was classed as a passenger carrier, and, accordingly, had to be operated by a licensed skipper. The vessel was renamed the "J.M. Swaine," and the first skipper was an old-time coastal navigator, Bill Cleveland.

One day, when the boat was tied up in the Victoria harbour, George Hopping, the entomologist from Vernon, happened to be visiting in Victoria. Thinking that he would like to see the much talked-of vessel, he wandered down to the ship, walked on board and found the skipper, Bill, sitting in the galley drinking a cup of coffee. Introducing himself, he said, "I'm Hopping from Vernon."

"Well," replied Bill, "sit down, boy, you must be tired."

In 1948 the Swaine's engine failed in Desolation Sound. Emergency sails made out of beating sheets were rigged on beating poles. This picturesque sail was quite inadequate to cope with the tide, however, and the vessel had to be towed to safety by its outboard dinghy and a friendly fish boat.

In its time, the J.M. Swaine served the B.C. coast as far north as Alaska, including the Queen Charlotte Islands. With the eventual development of public air transportation and an improved telephone service, the need for the vessel diminished. She was sold in 1953 and replaced by a smaller, faster vessel, the Forest Biologist. The J.M. Swaine, transformed into a towboat by its new owners, finally burned to the waterline while towing a boom of logs from Powell River to Vancouver.

With the retirement of Mr. J.J. deGryse in the early 1950's, the Division of Forest Biology came under the direction of Dr. M.L. Prebble. Dr. Prebble's approach to the administration of the science was vastly different from his predecessor. He was a determined and tireless worker: when Malcolm Prebble got going on something, it didn't matter if he didn't eat or drink or do anything else until he got done -- and he expected the same from the rest of us.

Dr. Prebble got down to the nitty gritty, proceeding to review and intensify all research projects in entomology and pathology. It was during his administration that much of the post-war developments took place, as described in the following review of the administrative organization of entomology in the Canadian Forestry Service in B.C.

M V J.M. Swaine rigged with beating sails
Desolation Sound, 1948 (PHOTO: Canadian Forestry Service)

Administrative Organization in British Columbia

As already mentioned, the first headquarters for forest entomology in this province was established under Ralph Hopping in the early 1920's in Vernon. In 1930, a sub-laboratory directed by George Hopping was established in Vancouver at the University of British Columbia. With the death of Ralph Hopping, George returned to Vernon. In 1940, a permanent forest insect centre was established in Victoria independent of the Vernon office. Spearheaded by Dr. M.L. Prebble and assisted by Dr. K. Graham, it was responsible for forest and shade tree pests on the coast.

By this time (1937), I had been moved from Vernon to Winnipeg to organize a new laboratory for the forest regions of central Canada.

In 1945 there was a major shuffle in British Columbia. The Victoria laboratory was made responsible for all forest insect problems in the province, Dr. Prebble was moved from Victoria to take over the newly opened research centre at Sault Ste. Marie, George Hopping was transferred to Alberta, and I was moved from Winnipeg to replace Prebble in Victoria.

Early accommodation for the Division of Forest Biology had been in the old post office building overlooking the Victoria harbour. It was subsequently moved into the new post office building on Government Street. In 1955, a site for a new laboratory on Burnside Road was purchased by the Federal Government. It was here that the cornerstone of the present laboratory was laid on August 13, 1963. This laboratory was enlarged to the its present structure in 1986. In 1970 the Vernon laboratory was closed permanently, and all personnel and projects were moved to the research centre in Victoria. The wisdom of this move has been frequently questioned, in view of the increasing importance of the interior forests and the never-ending problem of bark beetles.

Forest entomology in British Columbia has now been pursued actively for the past sixty years. The officers in charge through those years have been: R. Hopping, G.R. Hopping, M.L. Prebble, H.A. Richmond, R.R. Lejeune, P. Thomas, M. Drinkwater, and D.R. Macdonald.

In 1982, a joint agreement was signed by the federal Minister of Environment, the Honourable John Roberts, and the B.C. Minister of Forests, the Honourable Tom Waterland. This was a "Memorandum of Understanding Concerning the Coordination of Forest Research." In this document, the Canadian Forestry Service agreed to concentrate on forest protection research, including major problems of fire, insects, and disease, while the Ministry of Forests agreed to concentrate on silviculture and other related forms of forest management. This brought the B.C. Ministry of Forests into an aspect of forest protection previously administered solely by the federal government.

In 1980, Dr. Robert F. DeBoo was appointed Manager of Forest Pest Management in the Protection Branch of the B.C. Ministry of Forests in Victoria. At the same time, Peter M. Hall became the branch entomologist, and Pest Management Coordinators were appointed in each of the province's six forest regions. In 1981, John Henigman, pesticide specialist, and Dr. John A. Muir, pathologist, joined the Protection Branch. In the following years the Victoria offices hired additional technicians, while the regional offices began to hire entomologists and pathologists. This regional-level staffing was completed in 1985.

History of Academic Forest Entomology in B.C.

Forest entomology was first introduced into the curriculum at the University of British Columbia in 1947-1948, following the devastating outbreak of the western hemlock looper on the B.C. coast during the early 1940's. (This was the result of representations made to H.R. MacMillan that such a course should be available.) George Hopping, on loan to the university from the Federal Division of Forest Entomology, was appointed the first lecturer in 1947. He was followed the next year by Dr. K. Graham, who became the first Professor of Forest Entomology at the University. Dr. Graham's service continued in the Department of Zoology to 1967, when he and his speciality were transferred to the Faculty of Forestry.

With the retirement of Dr. Graham in 1977, the position of Professor of Forest Entomology was filled by Dr. John McLean. In association with Dr. John Borden of Simon Fraser University, Dr. McLean had just completed some intensive research on the development and use of pheromones (chemical attractants produced by insects) for the protection of logs infested with ambrosia beetles.

Forest entomology was introduced to Simon Fraser University in 1966 with the appointment of Dr. John Borden to the faculty. His speciality was the ambrosia beetle, and he was also a major contributor to the design of the Master of Pest Management Program which was first offered by the university in 1974.

In addition to its introduction at the university level, forest entomology was included in forestry courses at Malaspina, Selkirk, and New Caledonia Colleges, and at the British Columbia Institute of Technology (B.C.I.T.). Norman Alexander, who heads the teaching of forest entomology at B.C.I.T., served originally with the forest insect survey organization in the Victoria Canadian Forestry Service laboratory. It was here that he gained a fund of knowledge and practical experience that has been of inestimable value in the teaching of entomology.

Blake Dickens, who heads the teaching of forest entomology at New Caledonia College, had his introduction to forestry when, as a high school lad, he was employed as a cook on board the "J.M. Swaine." Without previous cooking experience, he reported for his first day aboard the ship with a fistful of instructions and directions prepared by his mother. He also brought along a determination to do a job as well or better than might be expected of him. That he did and with more than good measure.

The Forest Insect Work Conference

A very significant innovation emanating from British Columbia was the initiation of the Forest Insect Work Conference. This international organization was founded on October 13, 1949. The first organizational committee consisted of myself (British Columbia), Bob Furness (Oregon), and Jim Evenden (Idaho). The basic purpose of the conference was to promote communication among forest entomologists in western Canada and the United States on problems common to the forests of western North America.

This conference has met annually since its founding, and now is attended by 50 or 60 entomologists from the western states and western Canada. It is in no way a philosophical society for the presentation of scientific papers. It is a work conference pure and simple, where workers in various related projects become familiar with work of others on both a scientific and a practical level. (Interesting too, are the increasing number of female foresters who have entered the field of forest entomology.)

To further its objectives, over the years the conference has established certain basic standing committees, including: Programs and Arrangements Committee; Unpublished Reports Committee; Common Names Committee; Foreign Translation Committee; History Committee; and Ethical Practices Committee. This latter committee defies any reason for its existence, other than to recognize deeds and accomplishments over and above the functions of other committees, such as the moving of a hotel piano up to the seventh floor by passenger elevator after midnight (until the perpetrators were interrupted by the hotel police), and other such valuable contributions to a successful conference. With the increasing membership of the Forest Insect Work Conference, the Ethical Practices Committee was eliminated at the 1986 annual meeting.

Forest Insect and Disease Survey

One of the more noteworthy developments that revolutionized forest entomology as a service to the forest industry was the establishment of the Forest Insect Survey as a permanent and continent-wide division of the Canadian Forestry Service.

The Canada-wide Survey was initiated in 1936 by Mr. J.J. deGryse, the new Chief of the Division of Forest Insects of the Federal Department of Agriculture. The Survey had many objectives: the identification and recognition of our major forest insects; their distribution, biology, and place in the general ecology of the forest; the relationship of one species to another; and the appraisal of damage resulting from insect outbreaks.

It was an imaginative and challenging venture, one that would involve not only federal government personnel, but also the participation of the various provincial forest services and the major companies in the forest industry. Early stages of the program were seriously handicapped and greatly delayed in development through the war years, but with the termination of hostilities and the return of the war veterans, the Survey grew rapidly.

The expansion of the Survey created certain new problems, some serious, some frustrating, and some rather humorous. Among the more humorous (although not to those involved) was the inheritance by the Survey organization of unwanted surplus army vehicles, officially known as Heavy Utility Personnel Carriers, but commonly called the "HUPs." Built primarily for transportation across rough, open country, shell holes, rocks and all manner of obstacles, they were clumsy, noisy, dusty, possessed the comfort of a bulldozer, and, even worse, they were right-hand drives. These vehicles were issued to all insect rangers across Canada.

While efficient for their original purpose, when used for civilian work on paved highways at normal traffic speed, HUPs were subject to never-ending breakdowns. But since the vehicles were procured at no cost to the department, repairs were of minor concern. The principal objection was the interruption to Survey work schedules which resulted from such repairs. The use of these vehicles continued through the first few years of the Survey operation, until they eventually became worn out or just fell apart.

Biologically and economically, the Forest Insect Survey became one of the most important and visible parts of the Canadian Forestry Service. It also developed a tradition of providing good service to, and establishing good relations with, other forestry organizations. Forest diseases were included in the mandate of the Survey in 1961, and it was renamed the Forest Insect and Disease Survey. The concept has been adapted by co-workers in the United States and, with certain modifications, the Survey is now viewed as a program of continental importance.

Heavy Utility Personnel Carrier (HUP) at Red Coach Inn
Hundred Mile House (PHOTO: Canadian Forestry Service)

Forest Industry Contributions to Forest Entomology

In 1957, MacMillan Bloedel Ltd. became the first British Columbia forest company to employ a full time forest entomologist. To assume that position, I left the federal Forest Research Centre in Quebec City and returned to B.C. Of primary concern to the company was the ambrosia beetle problem, to which I was assigned on a 2-year project.

On completion of the 2-year term, the Council of Forest Industries of B.C. (at that time called the B.C. Logger's Association), continued the project under a long term retainer. The ambrosia beetle program was now expanded to include all interested companies associated with the Council.

This position went beyond work on a single insect. It was directed toward development of a working partnership between industry and government researchers on problems of current economic concern. These cooperative projects included field surveys for insect population trends, assessments of hazards of current insect situations, damage appraisals, and experimental and operational control programs. Typically the government agencies would supply the technical personnel, and the industry would supply the where-with-all to do the work. This might include helicopter rentals, accommodations, and skilled workmen.

Following the disastrous salmon kill that resulted from our DDT spray program directed against the black-headed budworm on Vancouver Island, an Insect Pest Committee was struck within the framework of the Council of Forest Industries (COFI). This was a standing committee whose chairman was appointed by the Board of Directors of the Council. Committee members represented each of the major forest industry companies, the Canadian Forestry Service, the Federal Department of Fisheries, the Provincial Fish and Wildlife Branch, and the B.C. Forest Service. At regular monthly meetings, the committee discussed all forest insect problems and reviewed all insect control undertakings. The committee always enjoyed a full turnout and was considered one of the most successful of the Council's standing committees. It was eventually terminated when other industry-government work groups came into being.

It was during this time that the Pest Control Committee recommended to COFI that it undertake the preparation of a field manual on forest pesticides used in the forests of B.C. The first edition came out in 1972, and a revised edition was produced in 1975. The basic purpose of the book was not to promote the use of chemical pesticides, but to give the user information about the application of the more commonly used pesticides, to outline their rightful place in forest management, and to reduce pesticide use to the lowest possible level consistent with the particular pest problem.

The field manual was produced in looseleaf form for easy revision, and its objective was to include the same range of pertinent facts for each chemical. Surprisingly, some of this data could only be found by endless searching through correspondence with manufacturers, researchers, and government and university authorities. The B.C. Ministry of Forests, in collaboration with COFI, has recently updated and expanded this book.

After seventeen years as consultant to the Council of Forest Industries of B.C., I retired, terminating more than 50 years of active participation in the field of forest entomology. Those last seventeen years were among the most satisfying and, I think, productive years of my career. This was due, in part, to the people with whom I was associated, but largely because it was an era of increasing participation of government and industry in a cooperative approach to solving forestry problems. This not only involved entomology and pathology, but also such inter-related problems as fisheries, wildlife, and recreation.

In retrospect, I can see that many notable developments have occurred in the practice of professional forestry. Today there is a totally different philosophy in dealing with forestry's many complex and inter-related situations, as well as a recognition of the value of the many facets of life that constitute the forest ecosystem and underlie the intricacies and importance of good forest management.

THE FOREST INSECTS

Detailed accounts of the more important forest insects are available at the Pacific Forest Research Centre in Victoria; here I will comment about matters of human and historical significance not included in a typical technical report.

Defoliating Insects

Of all forest insects on this continent, defoliators have been the greatest cause of forest losses throughout the years. In British Columbia, however, because of the rapid decline of defoliator populations after two or three years of intensive feeding, they place second in importance to the persistently destructive bark beetles. In every instance of applied insect control in this province, the infestation of defoliators has disappeared simultaneously in both the sprayed and unsprayed areas.

Nevertheless, defoliators pose a continuing threat to our forests, not only through the direct loss of killed timber, but also through retarded tree growth over a period of ten to twelve years, even if the tree recovers to normal health. Defoliator infestations may also kill the tops of young growth and produce loss of vigour in older timber. This permits the attack of secondary insects such as bark beetles and wood borers. While not all outbreaks of defoliators have prompted applied control, some have, either as experimental applications or as outright control measures. In any case, the spraying of insecticides over the forest in B.C. has been minimal in comparison with that undertaken in other parts of Canada, as summarized in Table 1.[1]

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[1]Table 1 has been modified from:

Henigman, J.F. 1984. Aerial application of insecticides in B.C. forests, 1929-1982. Pest Management Progress 4(2): 52. B.C. Ministry of Forests, Victoria.

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Shepherd, R.L. and I.S. Otvos. 1984. Can. Ent. 116:1533-42.
Shepherd, R.L. pers. comm.
(Note: R = Research Study)

Table 1. Aerial Application of Insecticides in B.C. Forests, 1929-1983[1]

Date	Insect	Locale	Insecticide
1930	Western hemlock looper	Vancouver watershed	Calcium arsenate
1930	Western hemlock looper	Stanley Park	Calcium arsenate
1946	Western hemlock looper	Nitinat and Sarita Vancouver Island	DDT
1948	Western false hemlock looper	Windermere	DDT
1948	Western false hemlock looper	Radium Hot Springs	DDT
1956	Western black-headed budworm	Port McNeill, Van. Is.	DDT
1956	Phantom hemlock looper	Central Park, Burnaby	DDT
1957	Phantom hemlock looper	Central Park, Burnaby	DDT
1957	Phantom hemlock looper	Queens Park New Westminster	DDT
1957	Western black-headed budworm	Port Hardy, Van. Is.	DDT
1959	Western hemlock looper	Stanley Park	DDT
1959	Green striped looper	Stanley Park	DDT
1960	Western black-headed budworm	Moresby Island Queen Charlotte Islands	DDT
1960	Saddle-back looper	Kitimat	DDT
1961	Saddle-back looper	Kitimat	DDT
1961	Pine butterfly	Cameron Lake, Van. Is.	DDT
1962	Douglas-fir tussock moth	Okanagan Valley	DDT malathion Nuclear polyhedrosis virus
1963	Western hemlock looper	Cowichan Lake, Van. Is.	Phosphamidon
1964	Western hemlock looper	Enderby	Phosphamidon
1964	Green striped looper	Graham Island, Q.C.I.	Phosphamidon
1965	Hemlock needle miner	Holberg, Vancouver Is.	Phosphamidon, dimethoate
1971	Douglas-fir cone and seed insects	Campbell River	Dimethoate
1972	Douglas-fir tussock moth	Okanagan Valley	Nuclear polyhedrosis virus
1973	Western false hemlock looper	Shuswap Lake area	Bacillus thuringiensis
1973	Western black-headed budworm	Port Alice area Vancouver Island	Fenitrothion
1974	Western false hemlock looper	Kamloops area	Bacillus thuringiensis
1974	Western false hemlock looper	Kamloops area	Altosid 5E
1975	Western false hemlock looper	Kamloops area	Bacillus thuringiensis
1975	Western false hemlock looper	Kamloops area	Acephate
1975	Douglas-fir tussock moth	Kamloops area	Bacillus thuringiensis
1975	Douglas-fir tussock moth	Kamloops area	Nuclear polyhedrosis virus
1975	Douglas-fir tussock moth	Kamloops area	Dimilin
1975	Douglas-fir tussock moth	Kamloops area	Acephate
1975	Douglas-fir tussock moth	Kamloops area	Bacillus thuringiensis
1975	Douglas-fir tussock moth	Kamloops area	Acephate
1975	Douglas-fir tussock moth	Kamloops area	Dimilin
1976	Western budworm	Mission area	Nuclear polyhedrosis virus
1978	Western budworm	Ashcroft, Cache Creek	Nuclear polyhedrosis virus
1978	Western budworm	Ashcroft, Cache Creek	Bacillus thuringiensis
1978	Spruce seed & cone insects	Prince George area	Dimethoate
1979	Spruce seed & cone insects	Prince George area	Dimethoate
1981	Douglas-fir tussock moth	Hedley	Nuclear polyhedrosis virus
1982	Douglas-fir tussock moth	Cache Creek	Nuclear polyhedrosis virus
1983	Western budworm	Ashcroft	Nuclear polyhedrosis and granulosis viruses

My earliest experience with applied insect control involved the Douglas-fir tussock moth. A native of central B.C., this defoliator almost certainly has been present in outbreak numbers periodically for as long as its host tree has existed. Of minor importance economically, the tussock moth does at times cause some concern, although the infestations are usually short-lived. Interestingly, there is a naturally occurring virus that serves as a biological control agent for the tussock moth. Recent work by the CFS has shown the effective use of this virus as a spray, resulting in almost complete elimination of the pest in the sprayed zone.

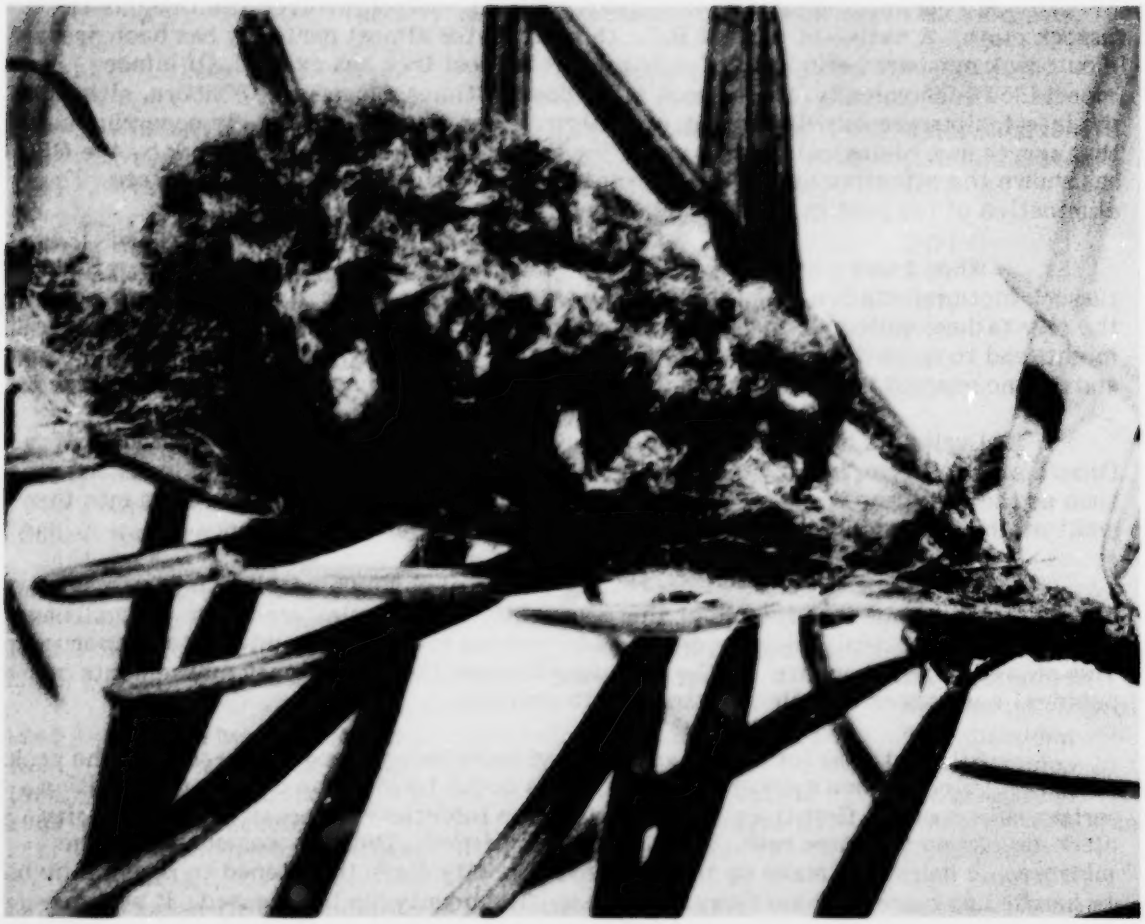
When I was a small boy living in Vernon, the city experienced a very severe tussock moth infestation. As there was no entomologist stationed in Veron in those days, the city fathers called an emergency session, seeking some inspirational guidance which might lead to some degree of control. All Douglas-fir trees within the city were in danger, and no one seemed to know any practical means by which the pest might be eliminated.

During its larval stage, the tussock moth feeds on the needles of Douglas-fir. Once mature, it crawls away in search of a suitable location in which to spin its cocoon, such as the walls and window sills of houses. Within the cocoon, it transforms into the adult moth. Each adult is capable of laying up to 300 eggs.

After serious deliberation, the town council came up with the idea of paying a bounty to school children to collect these unsightly cocoons plastered over the walls and window sills of houses. The city clerk would receive the cocoons and pay the rewards. This proved to be a bonanza for the kids, who forsook their customary amusements of nobbies[1] and soccer to collect tussock moth cocoons.

All went well for a time as more and more hairy cocoons poured over the desk of the city clerk. Then a crisis arose. The kids about town began coming down with a serious skin rash. At first it was believed to be an infectious outbreak — until the city clerk developed the same rash. Then the truth emerged. The rash was caused by the microscopic hairs that make up the cocoons. The city clerk threatened to resign if he had to handle any more of these hairy specimens. The bounty hunting ceased. It became imperative that a new method of handling the problem be found.

[1] A game that used two 6-inch pieces of garden hose connected with a cord, thrown and caught like a lacrosse ball with hook-shaped sticks.



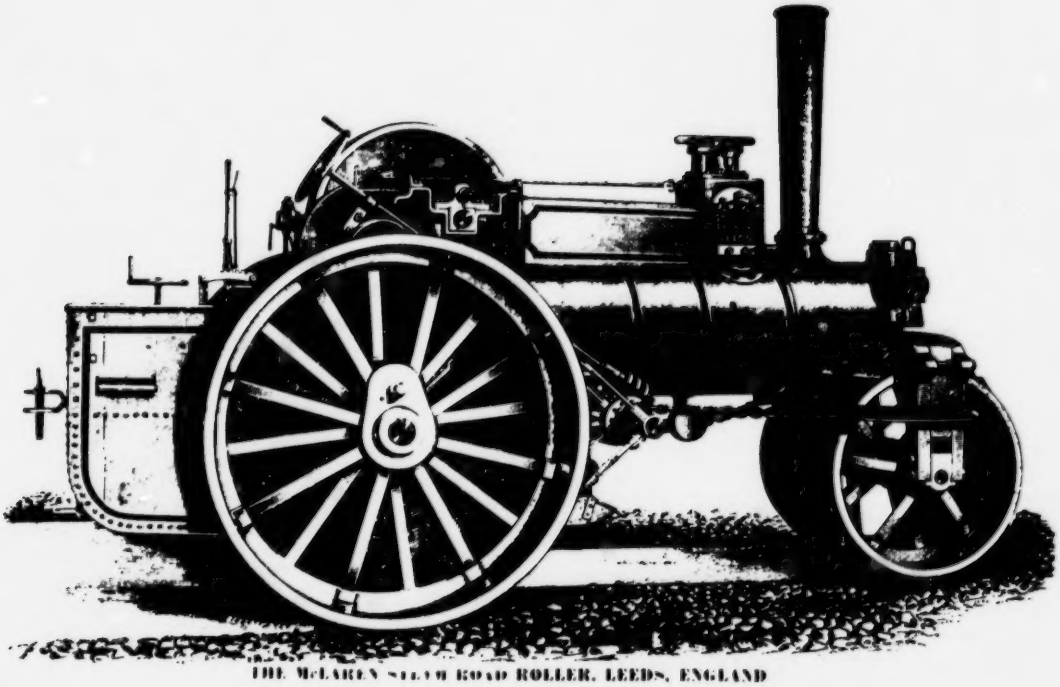
Douglas-fir tussock moth cocoon
(PHOTO: Province of British Columbia)

Again the city fathers called an emergency session, hoping for either new inspiration, or perhaps for some help from above. At last a dim light began to appear at the end of a very dark tunnel. They decided to enlist the services of Vernon's old steam roller and destroy the pest with jets of live steam.

The old roller was a huge contraption, only slightly smaller than a regular steam railway locomotive, and it weighed many, many tons. Its sole purpose in life had been to roll and compress gravel on roads and streets, since pavement was unheard of in small towns at that time. Running across the front of the machine was the principal roller, a steel drum about six feet long and some four feet in diameter. At the rear were two drive wheels, each some five feet in diameter, with steel rims about eighteen inches wide. It panted and puffed along the streets at a speed less than two miles an hour, pausing every now and then while the operator stoked more coal to keep the boiler going. It was an event to watch this monstrosity at work, especially for us kids.

For the destruction of the cocoons, it was decided to run two steam hose lines from the boiler of the steam roller, and with the help of two hose handlers, blast the cocoon-laden walls and window sills with live steam. This was calculated to wash away the cocoons, while at the same time steam clean the houses. This system worked just fine so long as the steam jets did not accidentally blast a glass window, especially plate glass. This did happen occasionally, and the glass would split and crumble as though hit by a baseball.

This unique and imaginative method of pest control continued through the season, but I never heard how effective it was. I know of no other use or advancement of this method, due, no doubt, to the fact that few people own a steam roller. Furthermore, it would run into certain practical difficulties in general use, particularly in mountainous forest country.



Steam road roller circa 1920
(From a poster by Good Roads Machinery Co.)

The earliest large-scale attempt at applied control against a forest pest in B.C. was in 1929, when a dust of calcium arsenate was applied against the defoliating western hemlock looper in Stanley Park and the Vancouver watershed. At each location, 800 acres (323.5 ha) was dusted at a rate of approximately 3 1/2 pounds of calcium arsenite per acre (8.65 kg per ha). It is interesting to note that in 1930 there was no public outcry against the use of an arsenical poison in the Vancouver watershed. The only complaints came from residents of North Vancouver, who objected to the noise of aircraft flying over their homes so early in the morning. The benefits of this attempted control were questionable.

The most devastating outbreak of a defoliator in the province occurred in the early 1940's, when the hemlock looper destroyed hundreds of acres of mature Douglas-fir timber on southern Vancouver Island and the lower mainland. Studies showed that, in most instances, the trees actually died from the action of the bark beetles and wood borers (Tetropium species) that invaded this weakened, defoliated timber. Douglas-fir has an amazing ability to recover from almost total defoliation, and without the subsequent attack by these secondary insects, tree mortality probably would have been minimal.

It was during this outbreak that DDT was used for the first time in B.C. as a forest spray. In the Nitinat and Sarita Valleys, DDT was applied at a rate of one pound per acre (2.47 kg per ha) over a total of 12,500 acres (5 058 ha). However, completely confusing the results or benefits of the spray application of DDT was the fact that a native viral disease swept through the hemlock looper population and brought a dramatic end to the entire outbreak within days. This precipitated the first field investigation of the influence of a native virus disease on the eventual control of a forest insect defoliator in Canada. The research was done by the insect pathology laboratory at Sault Ste. Marie. The disastrous effects of DDT on all aquatic life were not appreciated — or even suspected — at that time, so no investigation was made into any such effects.

Biplane used for aerial dusting
(PHOTO: Canadian Forestry Service)

Avenger aircraft used for aerial dusting
over Vancouver watershed, July 1949
(PHOTO: Government of British Columbia)

The most extensive chemical control program undertaken in the province was conducted against the black-headed budworm in 1957 in the Port Hardy region. Organized by the late Stan Hepher, this was a joint venture of the federal government and the forest industry. A total of 156,000 acres (63,130 ha) of forest were sprayed with DDT at a rate of one pound per U.S. gallon per acre (0.6 kg per ha). Although the benefits of this program were questionable, since the budworm disappeared in the sprayed and unsprayed areas simultaneously, two significant by-products emerged from the undertaking.

First, the spray program provided clear evidence that DDT was extremely destructive to all aquatic life in the sprayed regions. The mortality of salmon smolts in the Keogh River was disastrous. As a forest spray, DDT was proven to be totally unacceptable in British Columbia. This experience has been widely quoted, and it contributed to the eventual legal demise of DDT.

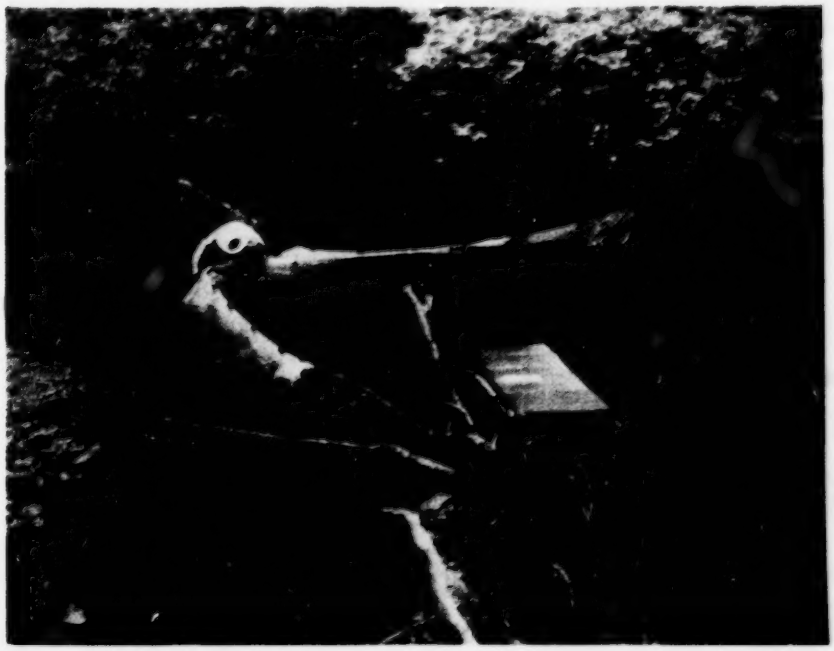
Second, because of demands from the B.C. forest industry for the development of more acceptable forest insecticides, a conference on forest spraying was held in Ottawa later that same year. It has continued on an annual basis ever since, and now operates under the title of "Forest Pest Control Forum." It brings together individuals interested or involved in forest spraying in Canada, including representatives from the forest industry, and provincial and federal government agencies.

In an effort to promote research into acceptable alternatives to toxic chemicals in forest pest control, the bacterial insecticide, Bacillus thuringiensis, was used for the first time in Canada as a forest spray against the black-headed budworm on the Queen Charlotte Islands in 1960. This material was in its infancy as a control agent and, while results were not particularly satisfactory, they were sufficiently positive to indicate its potential as a safe forest insecticide.

"Budworm Blitz": Loaded Avenger airplanes waiting to spray
Port Hardy, June 1957 (PHOTO: Government of British Columbia)

"Budworm Blitz": counting barrels of solvent
Port Hardy, June 1957 (PHOTO: Government of British Columbia)

"Budworm Blitz": Avenger spraying DDT over hemlocks
Port Hardy, June 1957 (PHOTO: Government of British Columbia)



"Budworm Blitz:" Fish trap and fish net being checked for
mortality among freshwater fish, Keogh River, 1957
(PHOTO: Government of British Columbia)

Helicopter leading DDT spray on hemlock looper
Windermere area, July, 1948 (PHOTOS: Government of British Columbia)

Spraying of the forest by helicopter was first attempted in B.C. in the Windermere country in 1948. DDT was applied over an area of 11,500 acres (4 654 ha) against the false hemlock looper. Results were uncertain since, as with the black-headed budworm, the looper disappeared simultaneously in both sprayed and unsprayed areas.

The only helicopter in the province available for this work was owned by Mr. Carl Jaeger of Penticton, who was trying to develop a crop spraying business. After his season's work on the Windermere project, he moved to Vancouver and initiated the company now called Okanagan Helicopters Ltd.

In the years that followed, researchers looked for suitable alternatives to DDT, and the federal fisheries department and fish and wildlife interests became involved in a cooperative approach to the problem. This led to a program to control the green striped looper on the Queen Charlotte Islands (Graham Island) in 1964 using the insecticide phosphamidon. Despite its extreme toxicity to mammals and bird life, it was apparently harmless to fish and all aquatic life. If properly and carefully used, it seemed that phosphamidon could be a potential candidate for forest use.

This project was sponsored and directed by COFI, with myself as entomologist. Other research personnel included two representatives from the Fish and Wildlife Branch, two from the Pacific Forest Research Centre, and one from the Federal Department of Fisheries. It involved several facets of investigation: the effectiveness of the insecticide in the dosage used; its possible effects on small mammals and birds resident in the forest zone of spray application, and its effect on aquatic life.

The bird population was assessed by recording the number and location of bird songs heard during a two-hour period immediately following daybreak. This was done on a daily basis over a period of ten or twelve days before and after the spray application. The effect of phosphamidon on small mammals was studied through the use of 200 white mice. Half of the mice were put in individual wire cages and placed throughout the spray zone, while the other half were located outside the spray zone. The mice were set out on location as close as possible to the spray application, and were to be left for two full days following completion of the spraying.

The program laboured under the handicap of three weeks of continuous rain, during which time the looper fed and grew to a size considerably beyond that of greatest susceptibility to the chemical. The 200 white mice were housed in an empty bunkhouse and fed and cared for, despite the ever-increasing nauseating stench.

When the weather eventually cleared, the spray trials were completed. The results showed moderate success of phosphamidon as an insecticide for control of the green striped looper, although results were not entirely satisfactory due to the three-week delay. There were no apparent ill effects on the mice or on bird populations. The mice were repacked and returned to their point of origin in Vancouver.

In 1965 a problem arose which was entirely new to us on the B.C. coast. It was an infestation of a needle miner in the Holberg Inlet region at the northern end of Vancouver Island. A survey of the affected area showed it to be widespread, and there was every possibility that some form of control would be necessary if conditions worsened. An experimental spray program was initiated immediately to determine an acceptable spray formulation for use the following year if the infestation persisted.

By nature, this mining beetle generally is protected from the outside influence of a contact spray, so a systemic chemical was indicated. Its compatibility with the environment would be of primary importance. Dimethoate was chosen for the trials.

The organization of the spray trials was similar to that of the phosphamidon trials on the Queen Charlotte Islands. It was organized through the Council of Forest Industries, and included entomologists from the Pacific Forest Research Centre and the federal Department of Fisheries.

While test areas were being prepared for helicopter trials, the fisheries scientists conducted some rather elaborate experiments on the effects of dimethoate sprayed directly over trapped salmon smolts. After spraying, the fish were kept for forty-eight hours to check for possible reactions. As there were no ill effects, the salmon were released, none the worse for the test.

Tests on the use of dimethoate on the needle miner proved to be entirely satisfactory, but as a natural collapse of the insect population followed, further work on the control program was cancelled.

In 1969 a serious infestation of the green striped looper occurred in the Holberg and Port Alice regions on Vancouver Island. Defoliation was intense, and an autumn survey of overwintering pupae indicated a massive population for the following summer. The need for control appeared to be certain, barring some unforeseen circumstances. In view of the results of the experimental sprays for the same insect in 1964 in the Queen Charlottes, it was decided to spray phosphamidon if control became warranted.

Accordingly, plans were made to mount an extensive spray program in the early summer of the following year. All spray ingredients were ordered, with a proviso for their return if they weren't used. Formulation of the spray was delayed until spring population surveys assured the need for an insect control program. Likewise, aircraft were contracted for the job with the contracts being subject to cancellation if they weren't required. A deadline for making final decisions was agreed upon by both the spray formulator and the aircraft company.

In the spring of 1970, field crews surveying the area for overwintered loopers found the forest litter honeycombed with tunnels. These appeared to be the work of small rodents, and the loopers were nowhere to be found. Over the winter the looper's natural predators had brought the insect under control. The entire spray program was cancelled without incurring any appreciable expense.

A similar event occurred in the Kitimat region, where a very large population of the saddle-back looper, (Ectropis crepiscularia), was totally eliminated by the overwintering feeding activities of an unknown predator (although there are indications that it may have been the martin). This too resulted in the cancellation of a planned control project scheduled for the following spring.

No review of defoliating insects would be complete without a discussion of the notorious spruce budworms. The outbreak which caused widespread defoliation in B.C. in the 1970's is often compared to the one which has devastated the forests of eastern Canada, but the two phenomena are in fact very different. The insects are two different species: Choristoneura occidentalis (western budworm) in B.C., and Choristoneura fumiferana (eastern spruce budworm) in the east. Compared to British Columbia, the forests of the east are much more uniform in tree species composition and age class distribution, and they extend across large expanses of flat country. B.C.'s high mountain ranges separate one deep valley from another, breaking up the forest into smaller blocks. The climate is more varied here as well. Furthermore, Douglas-fir, the principal host for the budworm in B.C., has a vastly greater capacity to recover from severe defoliation than has balsam fir, the principal host in the east.

The most recent western budworm infestation in B.C. developed in several geographically separate areas during the early 1970's. By 1976 defoliation was widespread, and entire mountain sides appeared to be dying. Defoliation was so severe in some areas that the needles, which provide both food and egg-laying sites for the insect, were in short supply. In other words, the large budworm population was in a shaky situation, even though surveys had shown no evidence of disease, parasites or other natural control mechanisms.

Under strong pressure for action from various quarters, the B.C. Forest Service geared up for a large scale control operation in the Fraser Canyon area in 1977. It became an extremely controversial issue both politically and socially, and when new field surveys and economic analyses by both provincial and federal government professionals did not support an all-out control effort, the spray program was cancelled at the last moment. The following spring brought a general collapse of the budworm population throughout the intended control area.

Despite this dramatic population decrease in the heavily infested areas, the budworm has persisted in other locations. The amazing recuperative powers of Douglas-fir have limited tree mortality, but recent studies by the Canadian Forestry Service show that budworm outbreaks earlier in the century produced considerable loss in both tree volume and height growth. The same sort of results can be expected from this outbreak.

As for the eastern spruce budworm, its recent history is a positive demonstration of the futility of attempting to eradicate a native insect from the forest. Spraying has been going on for some forty years, and it must continue indefinitely just to keep these forests alive. Dr. J.R. Blais, a research scientist working for CFS in Quebec, has commented on the situation in a recent issue of Forestry Chronicle: "What has been neglected are studies on the forest components of this ecosystem, the impact of the budworm on the forest, and especially the effect of the forest on the insect....Close to $250 million have been spent in the application of chemical insecticides against this pest in the course of the present infestation in eastern Canada. These control operations are only a stop-gap measure. They do not present a permanent solution. A solution to the problem, if indeed one exists, in all probability lies in forest management."[3]

What would have happened if the eastern spruce budworm outbreak had not been sprayed? Of course, no one knows for sure. If the infestation had been allowed to run its course, this cycle probably would be over by now and the eastern forests would be free of further attack for forty or fifty years. There would be a lot of dead timber, a major fire hazard, and a large salvage program. The money now being spent on spraying could well be put towards development and implementation of permanent forest management systems to reduce budworm losses.

While I realize that most westerners will say, "The eastern budworm is not our problem," there is nonetheless a very important lesson to be learned from this eastern budworm experience. We know very little about forest management of any of our forest insects, and there is a pressing need for this information. It is time we started to learn.

In retrospect, I think we may have been wrong to go in for aerial chemical spraying. I was actively involved in many such projects over the years, and I have seen applied chemical control produce enormous kills of defoliating caterpillars. But I have never seen an insect outbreak eliminated as a result of a spray program. In every case, the infestation eventually ended in sprayed and unsprayed areas at the same time.

Spraying a forest with a microbial insecticide such as Bacillus, or a viral insecticide, does not pose the same hazard to the forest ecosystem as was encountered in the days of the wide-spectrum toxic chemical insecticides. The movement away from these destructive pesticides is, I believe, one of the most important and significant products of pest control research of the present day. Much more still lies ahead.

The appropriateness of pesticide use is a very complicated question. It is not possible to give a set of cut and dried rules that can be applied to all cases. Many factors must be considered. These include: the degree of destructiveness of the insect; its tendency to persist at outbreak levels for a greater or lesser period of time; the possible long-term impact of spraying persistent populations; the age class of the trees and the likelihood of their recovery. Damage to young trees is of concern chiefly because of its effect on their present and future growth. In mature timber, where growth is already completed, survival of the trees is of primary concern. Aesthetic and environmental consequences of both infestation and control programs are difficult to evaluate, but these two factors are of great concern to both the industry and the public.

Bark Beetles

The attempted control of bark beetles in ponderosa pine in the Similkameen-Nicola region in the early 1920's constituted the first forest insect work ever undertaken in the province of B.C. This work was done by the provincial Forest Service, as the federal government had not, at that time, become involved in any forest insect work in the province. I participated in this control work for the first two years of its operation.

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[3]Blais, R. 1984. Canadian scientific achievement awards. Forestry Chronicle 60(6): 406.

Because the bark beetle spends most of its life buried between the wood and inner bark of a tree, it is relatively safe from any outside control operations. The only tried and true method of bark beetle control was to fell the tree, strip off its bark and branches, stack them up and burn them. Since the insect preferred to attack the larger and more mature trees, this method was slow and costly. At the peak of operations there were seven camps with thirty or more men each, cutting, debarking and burning pine trees. This work was concentrated in the period between early April and mid-June.

My job on that control work was that of a spotter. A spotter identified infested trees, marked them for felling, and recorded the diameters and age after they were cut. In addition to the spotting, I was also required to break in new men as spotters for other camps.

One day a delegation of Forest Service personnel arrived to undertake a first-hand inspection of the work. The group consisted of five men: the Chief Forester from Victoria, Mr. E.C. Manning; the District Forester from Vernon, Mr. Allan Parlow; the Forest Ranger from Merritt, Mr. Bob Little; the camp manager (I have forgotten his name); and myself. The five of us were accompanied by one of the fallers from the control camp, who carried a six-foot long crosscut saw. (This was long before power saws.)

The road on which we were walking passed in front of an old pre-emption (homestead) occupied by an old fellow who was notorious for his dry sense of humour and his cutting sarcasm. He stood beside a fence, one foot on the lower rail and elbows resting on the upper, watching us as we passed. In a clear voice, he counted: "One, two, three, four, five bosses." And as the sixth man followed, carrying the saw, he continued: "Say, that fellow must be a hard man to handle."

Bark from western yellow pine infested with western white pine beetle April, 1930. (PHOTO: Government of British Columbia)

Bark beetle control crew, Nought Valley, 1920's.(PHOTO: Hec Richmond)

The bark beetle control program continued through the 1920's and terminated in 1930. By that time it was apparent that the beetle infestation was spreading at a rate far in excess of the speed of the control operations.

In 1935-36 an overall decline occurred and the population dropped to an endemic level throughout the infested region. By then, however, most of the old-growth ponderosa pine had been killed, along with a large amount of lodgepole pine. What was left was a forest of young growth, exactly the way nature had intended in the first place.

Bark beetle research by the federal government was centered in the Apsen Grove region between Princeton and Merritt. As previously mentioned, the entry of the federal government (then called the Dominion government) stemmed from bark beetle control work initiated by the province of British Columbia. I was assigned to this work. The other two staff members involved in bark beetle research were Mathers in the Cariboo (spruce budworm), and G.R. Hopping on the coast (cedar pole borer and ambrosia beetle).

Despite the difficulties of the great Depression of the 1930's, bark beetle research continued through to the general decline of the main infestation in 1934. Research studies undertaken on bark beetles included: habits and general biology of the insect; its reproductive rate from year to year; the effect, if any, of overcrowding populations in a given log on egg population; host selection of the beetle; role of parasites and predators as natural control agents, and the significance of wood peckers and other birds in the destruction of beetles. Because of the prevailing Depression years and restricted funds, no results of these investigations were ever published. Indeed, the trend in Ottawa was towards the discouragement of publications of any kind.

An interesting unpublished record on the biological control of this insect centered on the activity of a predaceous fly, Lonchaea watsoni, Curran (Diptera, Lonchaeidae). This fly lays its eggs in bark beetle tunnels and, upon hatching, the resulting small maggots penetrate the larval mines of the bark beetle and feed on the bark beetle larvae. An extremely detailed study was made, when thousands of beetle tunnels were closely examined for activity of the larvae or their mortality. During the last year of the great bark beetle infestation, practically every beetle larva either was dead or was in the process of being consumed by the predaceous dipterous larva.

Dr. J. M. Swaine, the chief of forest insect investigations in Ottawa, and a bark beetle specialist, believed that a principal cause for the demise of this infestation would become apparent, and he instructed that field work should continue to the end in anticipation of discovering that one primary cause. It was during this long and extremely arduous work through the final two years that the predator was recorded. How common this may be for beetle infestations I have no idea, nor have I ever seen a report on this predator.

Hec Richmond with felled yellow pine
early 1930's (PHOTO: Hec Richmond)

The history of bark beetle research in British Columbia extends through to the present day, encompassing more than sixty years of experience. Bark beetles constitute a perennial problem, and are the number one enemy of B.C. timber. Responsible for annual losses of millions of dollars, these beetles are as much a part of the forest as are the trees themselves, and they are a problem with which we must live. The solution, if any, lies in managing these insects and the forest so that our losses are reduced to an acceptable level.

Bark beetles are nature's tool for disposing of overmature, decadent, or weakened timber. They are not new. They have always been there and will always be there so long as suitable host trees exist, particularly old-growth timber. Although the death of the tree almost always follows a beetle attack, this is not necessarily bad. There are definite instances in the province where stands of decadent timber have been eliminated by bark beetles and the area reforested with young, vigorous climax stands.

In British Columbia there are many thousands of acres of pure lodgepole pine, all of even age and mature. Much of this timber is doomed to beetle attack and eventual destruction. This is inevitable and should come as no great surprise. Resource managers in such areas should take into account this fact, realizing that the replacement with young growth will occur within one rotation (on suitable sites).

The loss of timber killed by bark beetles in remote areas that are totally inaccessible within the foreseeable future does not necessarily represent dollar losses. Indeed, one might credit the insect with contributing to good forest management. It therefore seems unrealistic to include all beetle-killed timber into the overall appraisal of dollar losses.

There is one very important fact I should like to stress. The European forests have been under management for probably three centuries. Foresters there have benefited from 300 years of mistakes and lessons, while we are just starting our first century of experience with forestry. We have yet to learn from our mistakes. In my opinion, therefore, it is most important that permanent study areas be established now in various problem areas so that the sequence of insect infestations, the forests response, and the areas' overall ecological patterns, can be recorded. Such study areas should not be followed through for just a few years, but should be planned as permanent study zones for, say, 100 years.

Historically, beetle control is as old as the insect's identification.
The first attempt was the felling, barking and burning of the whole tree. This proved to be effective for an individual tree, but it was an extremely slow, expensive and laborious process. Tried in the U.S. and Canada, it proved to be futile, the beetle infestation moving at a rate of speed far in excess of the rate of control.

Almost as old a control method is the use of "trap trees", a process designed to attract beetle populations to specially prepared logs, after which the logs are removed -- along with their accumulated beetle hord. This system has been used through the years and proves to be satisfactory to a limited degree.

There have been some rather extensive bark beetle control efforts in the United States, one being the spraying of the basal portion of the stem of infested trees. This was done on a large scale in Idaho, but to my knowledge the trees were protected only during the year they were sprayed, since the susceptibility of the trees to infestation persisted in the years that followed.

One of the most important ways of coping with bark beetle infestations is through salvage operations. But one of the prevailing obstacles in salvaging lodgepole pine is the development of blue stain in the sapwood soon after attack. This reduces the wood's value to the point that logging it is unprofitable. In some instances, the value of such stained timber has not been sufficient to pay the cost of hauling the timber to the mill.

The alternative to salvage is to be able to predict the spread of the infestation and harvest the targeted trees in advance of the insect. This is largely guess work, except in the immediate vicinity of infested trees.

Another approach is to cut the infested trees immediately after the attack occurs, before the stain develops and the tree foliage discolours. This requires the immediate identification of infested trees, a difficult but not impossible challenge. This involves examining the sapwood, which will indicate beetle attack more accurately than pitch tubes or other indicators.

Further complicating the picture is the need to understand the biology of the insect. Overwintered adults attack forests in early spring, and the young current brood attack later in the year. These attacks can vary with local weather conditions. Understanding this insect for management purposes is not a simple task.

More recent control efforts involve the use of beetle traps, baited with bark beetle pheromones, to contain spot infestations. This method is discussed in more detail in the next section.

Ambrosia Beetles

Of all wood boring insects (as distinguished from bark beetles), none have a greater economic impact than the ambrosia beetle. This small black wood borer infests newly felled timber by mining small tunnels into the sapwood where it breeds and produces its young. All tree species are attacked, with cedar being the most resistant. Since this is primarily a west coast problem, practically all ambrosia beetle research in Canada has been done here.

Dollar losses caused by the ambrosia beetle are difficult to determine because there are so many variables. Some of these include: lumber milling methods, which in turn depend on the market for which the logs are milled; grading rules, which depend on whether the lumber is for export or local sales; size, grade, and type of log affected; number of beetle holes per unit area; and other factors as well.

An intensive and detailed study of costs attributable to the ambrosia beetle was undertaken jointly by the Pacific Forest Research Centre and Forintek (called at that time the Western Forest Products Laboratory). The study was directed by Clark McBride, a specialist in conducting sawmill studies, and James Kinghorn, a specialist on ambrosia beetles.[4]

Logs were cut individually after all the necessary data had been recorded, and the lumber produced was also analyzed. Losses were calculated according to both North American and overseas prices and grading rules. Based on 1957 prices, and according to grading rules for overseas export, losses were $2.80 - $9.10 per M fbm for fir, and $1.30 - $7.60 per M fbm for hemlock.

The principal target of the ambrosia beetle is the green-cut log, either in the woods or floating in a boom. Logs on land are attacked on all sides, while logs floating in water are attacked on their upper exposed side. Although chemical insecticides can reduce an ambrosia beetle attack, it is physically impossible to spray the undersurfaces of logs lying in the woods. Historically, the only practical treatment was to get the logs to water before the insect could attack, then spray them after booming.

The early chemical control of the ambrosia beetle was restricted to benzene hexachloride (BHC). This was used for the first time in a hand spraying operation on Cowichan Lake in late 1949. In the mid-1950's, B.C. Forest Products undertook some control operations on Cowichan Lake using hand spraying from a floating barge.

In 1958, MacMillan Bloedel attempted a large-scale operation on Alberni Inlet. A three-man crew on a floating raft carrying a fire pump and spray materials was towed from location to location. Two men operated handheld hoses, and each log was sprayed individually with an emulsifiable concentrate of BHC diluted with water.

The procedure was slow and costly, and because of this, aerial application was attempted. Although rapid and effective, the fixed-wing aircraft had the disadvantage of being unable to fly low enough to the logs due to the hazards of pilings and other obstructions near the shoreline. Furthermore, it flew too quickly to permit an accurate drop on such a limited target as a log boom.

In 1959, tests were made using a helicopter. In addition to overcoming the principal disadvantages of fixed-wing aircraft, the helicopter had the advantage of being able to operate from a barge towed to the booming grounds. Henceforth control operations were restricted to helicopters.

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[4]McBride, C.F., and J.M. Kinghorn. 1960. Lumber degrade caused by ambrosia beetles. B.C. Lumberman 44(7): 40-52.

Experimental spraying for control of ambrosia beetle
September, 1959 (PHOTO: Government of British Columbia)

Examining log boom after spraying for ambrosia beetle
September, 1959 (PHOTO: Government of British Columbia)

Preliminary spray tests used an oil concentrate with an emulsifier diluted with water. This formulation was applied in sufficient quantity to drench the bark of the log, but it also mixed readily with the water in which the logs were floating. Caged coho salmon held as deep as 64 inches (1.6 m) showed immediate toxic effects.

The program was then modified using an undiluted oil concentrate, without an emulsifier, applied as a fine mist over the log surfaces. This produced only a fine oil slick on the water between the boomed logs. Caged fish showed effects only in the upper six-inch level, with most of those affected having actually come in contact with the surface oil slick. As a further safeguard, all spray applications were completed by mid-April, before the main migration of juvenile salmon from freshwater streams to the sea.

The dosage per acre consisted of 10 gallons of concentrate containing 10 pounds of the gamma isomer of BHC. It was applied without a dilutent. A helicopter load was 45 gallons (205 l), sufficient to cover four, eight-section flat rafted booms. The average time needed to drop each load, including ferrying, spraying and loading, was 15 minutes.

Because of the undesirable side effects of BHC (similar to those of DDT), it was apparent that there was an urgent need to develop a better means of log protection. Through research sponsored by the Council of Forest Industries, a suitable replacement for BHC was found — an organophosphate called methyl trithion. This was as effective as BHC in controlling the ambrosia beetle, but due to its shorter effective life, any application had to be carefully timed to coincide with beetle activity. Methyl trithion had no apparent ill effect on fish, and it was practically odourless.

Methyl trithion replaced BHC as a log spray in 1968. Nevertheless, objections to the application of any kind of toxic chemical on Cowichan Lake were placed before the provincial Ministry of Health by Cowichan residents in early 1970. The outcome was the outlawing of all poisonous material on all fresh water in the province. Spraying of logs on salt water was approved, due to the more rapid dilution and breakdown of the chemical in salt water.

However, spraying on salt water came to a halt when, in 1970, the International Woodworkers of America (IWA) refused to handle any logs on Alberni Inlet that had been sprayed. Similar opposition developed at the log sorting grounds at Teakerne Arm on West Redonda Island. It was obvious that opposition to spraying was widely based, and the industry abandoned any further attempts to use pesticides for log protection. During the life of this control technique, more than 73,000,000 fbm of timber were sprayed (Table 2).

Table 2. Summary of Log Boom Spraying 1961-1969[5]

Total volume of insecticide used	24,344 gallons
Total area of log booms sprayed	3,234 acres
Total log volume sprayed	743,427,000 fbm

With the termination of log spraying, the Council of Forest Industries focused their log protection efforts on dry land sorting grounds. A technique was developed in which the air surrounding the log storage area was enveloped in a mist of water pumped from the sea. A pilot test model was established on MB log storage grounds at North West Bay. By this system, a continuing fog of water saturates the air throughout the storage grounds and discourages the flight of ambrosia beetles into that region.

Following these trials, a full scale system was installed in the storage area of B.C. Forest Products at Port Renfrew. In this installation, all water pipes were underground, and risers with sprinklers were installed so their removal would take but a few seconds (to allow the use of heavy equipment without disturbing the sprinkler installation.)

Assessment of the effectiveness of this system for protecting logs from ambrosia beetle atack was conducted by a research team from the Canadian Forestry Service. When operated on a continuous schedule from dawn to dark, the system provided 100 percent protection to all logs throughout the entire storage area. Its main drawbacks were that it was expensive to install (included were the cost and operation of electrical pumps), and it required a constant supply of water and a good drainage system. But for the Port Renfrew operation, it was regarded to be a sound, effective venture.

The most recent development in protecting logs from ambrosia beetle invasion is the use of pheromones. This system uses the synthetic versions of natural lures produced by the adult beetle to attract others of the same species. Through the baiting of specially designed traps, invading beetles can be lured to their eventual death.

Developed originally by Drs. John Borden and John McLean at Simon Fraser University, this control method is now being used by the forest industry and the Ministry of Forests.

The use of pheromones has application in the management of other pests, particularly bark beetles. This again is a notable divergence from the use of poisonous chemical insecticides, and its future would seem to be unlimited.

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[5]H.A. Richmond, unpublished data

Water misting installation for ambrosia beetle control
(PHOTO: Hec Richmond, Forever Green)

Lindgren funnel pheromone trap for ambrosia beetle control
(Photo: Canadian Forestry Service)

Ironically, the progressive development of techniques for ambrosia beetle control would not have taken place if there hadn't been strong public opposition to the early control programs. Each of those methods had its problems, making them unsatisfactory to various groups. This in turn forced the development of new and different control techniques.

Unquestionably, the best course of action for minimizing losses from ambrosia beetles is to carefully manage and schedule the logging, storage and utilization of saw logs. An intensive program based on these principles was undertaken by MacMillan Bloedel. This involved minimizing the amount of time that elapsed between the felling, yarding, hauling and milling of green timber. Such a program can become very complicated, affecting not only logging operations, but also log storage, transportation, and mill operations. It can also run into a considerable additional expense.

During my time with the Council of Forest Industries, we put together a study to see if logs held in different storage areas on the coast were any more or less susceptible to ambrosia beetle attacks. Logs for the study were all felled in October of the previous year, since timber cut in the fall is always the most susceptible to beetle attack the following spring. After being made into booms at North West Bay, the logs were towed to specially designated tie-up areas that included the estuaries of the Nanaimo, Fraser and Chemainus Rivers, the Fraser River at Harrison Lake, Howe Sound near Gambier Island, and Alberni Inlet. These booms were examined every two weeks during the beetle season, and each log was checked for signs of attack.

The hazard to stored logs was found to be directly related to the proximity of forest growth to the storage area, and to the length of time that area had been used for storing logs.

While ambrosia beetle losses can be greatly reduced by carefully planned and enforced utilization schedules, the success of this approach will be dependent, to a large extent, on which department within the company absorbs the additional costs. This is an extremely important point to be settled at the outset before undertaking any such program.

CONCLUSION

We have emerged from what may well be called an era of "extractive" forestry, whereby we harvested the old growth, grown by nature, at no cost to man. We are now entering an era of man-made forests and intensive forest management. Unlike the old growth, the new forests represent huge investments in their production, protection, and administration. No longer can our forests be considered a source of direct revenue for the provincial treasury. Money derived from the forests must be reinvested in those forests if we are to achieve acceptable standards of forest management. The forest must be evaluated in terms of jobs created and products produced. This philosophy may be hard for the public to realize and for the politicians to accept. This political aspect may prove to be the most serious stumbling block in the future as we move toward more intensive forest management.

Forest management is a sphere of forest science involving such disciplines as pathology, silviculture, tree physiology and others, not the least of which is entomology and the control of forest insects. No longer do we subscribe to the nozzle-head control philosophy so pronounced in the heyday of chemical insect control in the 1940's and 50's. This has given way to an entirely new, environmentally compatible and permanently effective concept of pest control through good management.

With the ever-increasing participation and concern of the public in all aspects of pest control, it becomes imperative that all views be regarded with due respect and understanding. An atmosphere of confrontation achieves nothing, as my experience on various occasions in the past has shown. I would stress here that good constructive opposition is an essential ingredient to advancement and success, whether in business or in science.

Recent advances in research have resulted in the introduction of such controls as insecticidal soaps, pheromones, insect pathogens and intensified management. These have already proved their value and have opened the door to an enormous field of investigation in the realms of entomology and pest management. It is the dawn of a new day, and points the way to ever increasing advancement for the future.

TWELVE CARDINAL POINTS IN PEST MANAGEMENT

1. No problem is ever finished. At best you will have learned only a small amount about what to do, but a great deal about what NOT to do.

2. Familiarize yourself with your predecessor's mistakes, and don't repeat them. Don't be ashamed of your mistakes — profit by them.

3. The eradication of any NATIVE species of forest insect is impossible. They are as much a part of the forest as are the trees themselves. They have been there as long as the trees have, and will continue to be so to the end of time.

4. Today's concept of pest management is to control the damage, not the insect. This is a lesson learned through years of experience, expense and frustrations. Think modern.

5. Industry is inclined to become extremely panicky in the face of a serious infestation. Following a "fire control" philosophy, industry demands an immediate chemical control program in the hopes of immediately eradicating the pest. This attitude is frustrating, futile, and has proven to be very impractical in most instances.

6. Regard all views of a situation with respect and understanding. Confrontation between factions achieves nothing.

7. Strong opposition is an essential ingredient to success, and sometimes your opponent MAY be correct.

8. Remember to wonder if the so-called "expert" is speaking with an open mind without prejudice, or is he "beating a drum" in the interests of himself or others?

9. Do not confuse an issue in eastern North America with a similar problem in the west. While the species of insect may be the same, most other factors will be totally different.

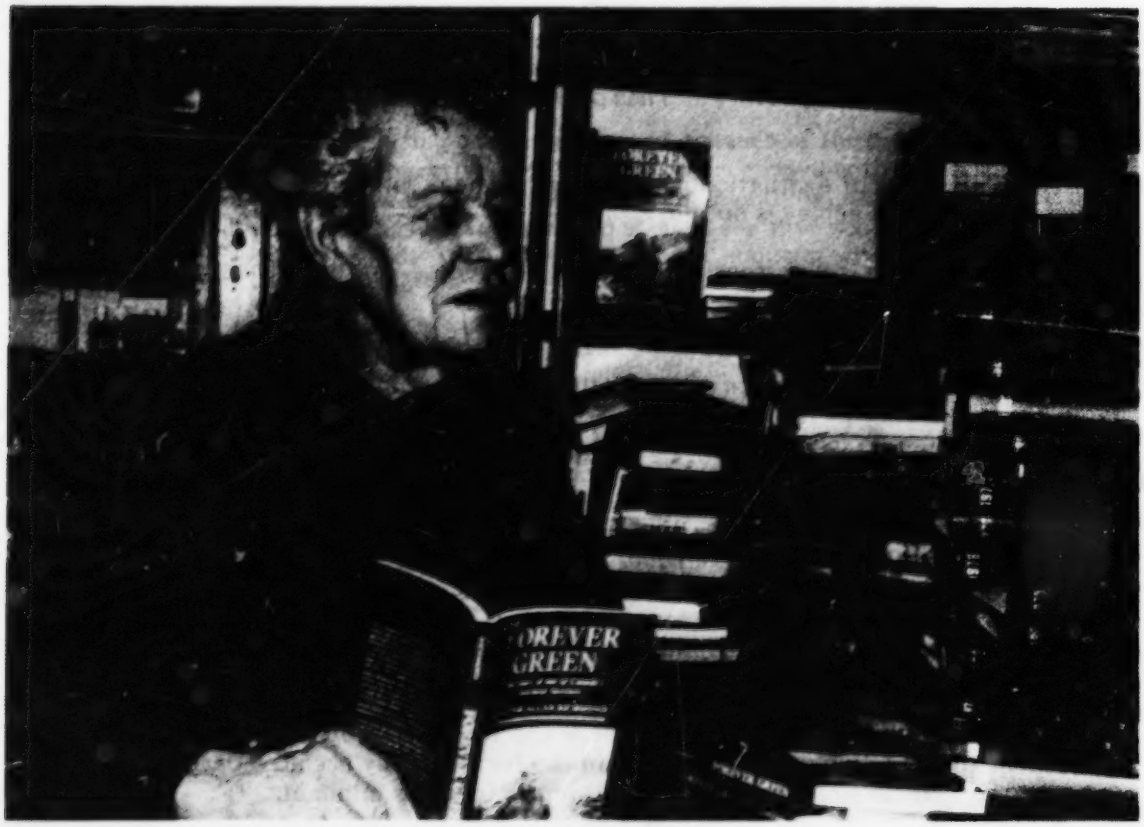
10. You cannot lose something you never had. Remember this when appraising dollar losses of killed timber, especially in remote areas. Nature teaches us that the passing of one life is to make room for another. A killed forest on a good site eventually will be replaced by another, frequently much superior forest to the one that was destroyed.

11. Think about what the insect is doing FOR the forest, as well as TO the forest. Have respect for ALL living organisms within the forest. They are all a part of the forest complex, and our knowledge of life within the forest is minimal.

12. Develop self discipline — learn to be patient — believe in hard work, believe in yourself -- and be yourself.

BIOGRAPHY

Hector Allan Richmond was born on a cattle ranch in Oklahoma in 1902. He moved with his family to Vernon, B.C., in 1911, where he completed his elementary and secondary schooling. He graduated from Oregon State University in forestry, and later took a Master's degree at McGill University. He was employed by the Canadian government for 30 years as a forest entomologist, then served as a consultant to the Council of Forest Industries of B.C. for 16 years. His work has taken him into most of the forest regions of Canada. He is a charter member of the Association of B.C. Professional Foresters, a Fellow of the Canadian Institute of Forestry, and the founder of the Western Forest Insect Work Conference. He now lives on a waterfront farm on Vancouver Island. He has written a book of reminiscences (Forever Green, published by Oolichan Press) and is working on a sequel.



Hec Richmond at his home near Nanaimo with a copy of his book Forever Green and his collection of diaries

EPILOGUE

by Bob Wood, R.P.F.[6]

Hector Richmond has written a comprehensive and good-humoured history of forest entomology in British Columbia. Only Hec could have done this topic justice because he has actually been part of that history virtually from the beginning, because he has been a compulsive diarist all his life, and because he has the wit and literary skill to present it so well. He has participated in, recorded first hand, and now compiled that history.

Hec Richmond's history, however, presents the forest entomologist as a somewhat peculiar and exotic participant in the forest management process. He has tended to be a rare specimen set apart. It seems now that this perspective is in process of rapid and welcome change. Forest management, including forest protection priorities, is changing enormously. We face very great challenges as we move from the final phases of old growth timber harvest towards the management of new stands. The scope for error in this process is enormous because we simply have not been through the experience of even one forest rotation. We have many mistakes yet to make. Because of this, it is essential that the historic perception of the entomologist as an isolated specialist, or for that matter, of any other specialist as isolated, be a thing of the past. The solutions for the mistakes yet to be made and challenges yet to be overcome will require the dedication of a wholly meshed and integrated array of all the specialties into a coherent management team. We no longer have the luxury of time to function as groups of groups.

In this regard, we all recall the time in 1976 when the Fraser Canyon appeared to be on the verge of a major budworm epidemic. All the artificial mechanisms available to man had been assembled and marshalled for the assault. At that time, I was an advisor to the Minister of Forests and I sought Hec Richmond's advice on the problem. He said simply, "Wait a year and it will probably collapse." This advice was passed on but was declined because plans and commitments were too far advanced. Public pressure intervened, however, and the program was delayed and, sure enough, the following year the outbreak collapsed. A year later on my final day as advisor to the same Minister, he returned to me the note I had written him urging acceptance of Hec's advice. He told me, "This is the one piece of advice I wish I had accepted but didn't." This episode illustrates the wise and balanced philosophy which derives from the author's historic review of forest entomology. The message is "think nature" and "think modern." It also sadly illustrates, however, that peculiar historic isolation of the entomologist. Had an integrated and symbiotic combination of talents been equally present, an error could have been avoided.

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[6] Robert S. Wood, R.P.F., is senior partner in Sterling Wood Group, Inc., specializing in forest policy and management consulting. During the period of 1975-78, he was Senior Special Forestry Advisor to the (then) Minister of Lands and Forests of B.C. in the preparation of new forest and range legislation. Among other past responsibilities, Mr. Wood served as Vice-President in charge of the Forestry and Logging Division of the Council of Forest Industries of B.C. In 1980, he received the Distinguished Forester's Award from the Association of B.C. Professional Foresters, in part for his involvement in work on the Douglas-fir beetle, and in the establishment of the Forest Land Use Liaison Committee.

In the 1950's I knew Hector Richmond by his fame, in the 1960's as an acquaintance, in the 1970's as a professional associate, in the 1980's as a neighbour, and all that time as a friend. It is a privilege to have had the opportunity to review this historic sketch and to become acquainted, or reacquainted, with that procession of esteemed pioneers who have brought the "science and art" of forest entomology to its present prominence. History never ends and, hopefully, we can all strive in the continuing process to think nature and think modern. Hector Richmond always has and still does.

As we approach the 75th anniversary of our truly venerable Forest Service, let us hope that real professional integration is finally achieved in that Forest Service, that the spectre of the isolated and lonely specialist is lost forever, and that real forest management is conducted by a blend of all the talents. The forest management challenges faced by all of us are too great for it to be otherwise. We all have to think modern as a unit.

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